

5 Multidisciplinary and international virtual collaboration on the “Shared Garden” between the Universities of Bordeaux and León

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Abstract

This case study describes two iterations of a cross-disciplinary Virtual Exchange (VE) project developed between the Universities of Bordeaux (France) and León (Spain), involving students of Applied Physics and Measurement Engineering (APME), and Electrical Engineering. The students worked together on designing a real garden in Bordeaux within ecological and sustainable parameters. This Project-Based Learning (PBL) activity helped them develop both their content knowledge and their competences in English, teamwork, time management, and self-evaluation.

Keywords: virtual exchange, science competences, intercultural competences, transnational exchange projects, project based learning (PBL), engineering.

1. Context

This VE project, entitled the Shared Garden, is the result of a fruitful collaboration between the University of León in Spain and the Institute of Technology of Bordeaux, part of the University of Bordeaux in France. This collaboration

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began in 2018 after the two authors followed a training program to develop transnational exchange projects, and has seen two iterations of the VE project, one in the academic year 2018-2019 and one in 2019-2020.

The French students taking part in the project are undergraduate students and more precisely second year students enrolled in the APME department. The students in Spain are also undergraduate students but from the fourth year of the Degree in Electrical Engineering of the University of León. They are studying Fluid Mechanics Engineering in English, which involves six ECTS. As part of their studies, they participate in one PBL activity which develops their theoretical and practical knowledge as well as their competences in English, teamwork, deadline tracking, and self-evaluation methods.

In the French department, some students follow the international track, which provides 30% of science classes taught in English. These students also get extra classes to help them upgrade their scientific vocabulary, improve their communication skills, and prepare them for their mobility since all the students have to do their compulsory internship abroad. As part of the project, the students had to carry out a tutored project, which gave them a first impression of their future placement. Indeed, they had to organize themselves to complete various tasks.

Developing VEs is not a new activity for language teachers (Guth, Helm, & O'Dowd, 2014); many people may still remember their penfriends from all over the world. But this project goes one step further since it combines science and intercultural competences (Lewis & O'Dowd, 2016). The teachers involved in this project are interested in working with other countries, so it has enabled teachers from different scientific areas to take part in an international experience. It is supervised by three academics: on the French side a language teacher (Mr Villard, researcher) and a science teacher (Mrs Taris); and on the Spanish side, an associated professor specialized in fluid mechanics (Dr Fernández-Raga, researcher) who also manages the project. The three teachers share a passion for environmental issues.

2. Aims and description of the project

The international VE is part of a compulsory tutored project proposed to the second year students of the APME department.

The project, called Shared Garden, is centered on a physical area situated on the campus in Bordeaux, given to the students in order to allow them to design a garden under the philosophy of ecological and sustainable parameters. They can plant, design their watering system, measure humidity and production, and use all these ideas to discuss and explore the possibilities and consequences of their decisions. Because the French participants are second year students, they have less experience in technical solutions, so the Spanish students help them to design elements to allow them to save water in their garden. It is called Shared Garden because of the collaboration of students of different years and countries working together.

There have been two iterations of the project, one in the academic year 2018-2019 and the second one in 2019-2020. In both cases the aim was twofold. First, the goal was to help our students (nine in total the first year with three French and six Spanish, 15 in total the second year, with six French and nine Spanish) get a better insight into water shortage issues by imagining a cheap eco-friendly watering system, which could be used for our Shared Garden. Secondly, the project was also designed for our students to improve their communication skills by working in English and to work with an international team; thus, working on their soft skills, such as communication, team work, and problem solving, would be helpful to navigate their future professional life. Because of different academic calendars at the University of León and the Institute of Technology in Bordeaux, the project ran from October to May. It was organized into three different steps: first, the French students worked on their own from October to late January. They familiarized themselves with the subject by doing some research on water consumption in general, and by trying to find innovative eco-friendly watering systems. Then, from February to early April, the French and Spanish students worked together on their ideas through the VE. Finally, the

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Spanish cohort worked on their own from April to May, creating scale models of the irrigation systems and testing them. The reason for starting at different moments was because the teachers involved needed to adjust the project to the timetable or their subjects, so the French students started during the autumn semester while the Spanish students started their fluid mechanics module in February.

Because of the size of the group, the French students worked in three pairs, each group working on a part of the project. Some students focused on the soil and its quality by interviewing farmers to assess the water shortage issue and come to conclusions on the type of plants that needed to be planted in the garden. Two other students worked on the irrigation system and another pair worked on the valve system. During all this period, not only were the students supervised by their French teachers, but also by the Spanish colleague several times using Zoom, which helped her get to know the students, discuss with them the various issues, and help them in deciding about the irrigation system.

As the Spanish teacher is specialized in fluid mechanics, she was able to help the students decide on which system to adopt; the French science teacher helped the students with the sensor technology, while the English language teacher made sure that the communication went smoothly. The French students communicated mostly in French but wrote in English so the international experience with VE forced them to use more specialized English. Luckily for the project, Mrs Fernández-Raga was able to visit Bordeaux in the middle of January to meet the French team, see the garden, and check on the students' ideas. This visit was very much appreciated both by the students and the French team, and it helped to explain to the French students the details of the next collaboration with the Spanish students.

In February, the French students presented their ideas and progress to their Spanish peers, and together they decided on some ideas to improve their projects, taking into account that the Spanish participants were fourth year students of Electric Engineering, so they had greater knowledge of fluid mechanics. The role of the Spanish students was to listen to the oral presentations of the French

students and to give them ideas for possible improvements of the projects (improvements in the watering systems, ideas to recover water from the rain, or similar). The presentations, which were organized in plenary groups, lacked a structure. As the Spanish students also had more experience in presenting projects, these presentations offered a good opportunity to show the French students that structure is essential for presentations to be clear.

3. Pedagogical design and tools

As was said previously, the French students' activities done from October until January were presented to the Spanish students in February, to allow them to think about ideas to improve the work done. Just after that, the students were divided into small groups of four students depending on the number of students in each year (three Spanish and one French, or two Spanish and two French), in order to make well-balanced international groups.

After the presentations, a PBL activity was proposed to the students, who had to decide on a challenge or improvement of the project that they would like to develop together. The ensuing discussion allowed the students to exchange opinions with peers, organize how to deal with the challenge as a team, think about each-other's abilities, skills, and weaknesses, and manage the time working in a group. The teams communicated in English, which is highly relevant in terms of developing their ability to work in an international environment where English could be used as an international language. Other abilities were also developed, because time management, resources, efforts, and schedules had to be adjusted to an international context. Therefore, the members of these teams organized meetings through the Zoom platform, which allows to hold and record video conferences, to chat, to share documents, and to make presentations to share their results with other teams in a plenary meeting with all the Spanish and French students.

Following the teachers' instructions about how tasks should be accomplished, each international team of four students needed to elaborate a PowerPoint

presentation about an improvement in the Shared Garden, testing their ideas and showing their results to the rest of the class involved in the PBL in May. The idea was that all the students had to evaluate the work of the other students. Each student had to give a mark to the peers of their own group, and to the other teams' presentations.

To develop the PowerPoint, each group of students was allowed to use any available tools such as WhatsApp videos, Google Docs, Zoom, Skype, Trello, or any other means they found relevant. They needed to provide answers to a challenge that could be either scientific (answering a question about fluid mechanics) or linked to engineering (construction and testing of a prototype). In both cases, they needed to communicate in another language (English), so the students involved in this activity had to develop skills such as communicating in a foreign language to a non-expert audience (since French students had less training in fluid mechanics than their Spanish peers). Furthermore, during the two months of this activity, students had to resolve small conflicts, organize meetings, and plan assignments. Teachers acted as guides, and were able to participate and contribute to the students' knowledge despite the distance, integrating knowledge from their different fields (language and engineering). In addition, the project was integrated with an activity of co-teaching, where the French science teacher traveled to teach the Spanish students in March, and the Spanish engineering teacher went to Bordeaux to teach the local students for a week. One of the main advantages was the interdisciplinary approach to this activity, which combined English and Science, allowing a more comprehensive, ecological, and valid solution to a complex problem like the global awareness of drought issues.

4. Evaluation and assessment

One of the most difficult parts that we had to design in this activity was the evaluation process, because of several aspects such as the distance, the different grades of the students, and the different criteria of the teachers involved. Participation in this activity was voluntary for all the students. They were

informed of the activity, and the possibility to improve their ability to work in European teams, adapting to different schedules, ways of working, and ways of expressing themselves. During the first iteration, the French students did not take this activity seriously since there was no formal assessment. If students are not highly motivated, their skills will not improve much. So, in the second iteration, we proposed to have some academic assessment, maintaining the activity voluntary for the Spanish students but compulsory for the French students. The final PBL presentation that the students had to produce at the end of the project on the application of fluid mechanics concepts accounted for 15% of the global grade, but this mark was the result of the combination of the evaluation given by all students and teachers involved. The mark obtained by each student was made up of the average grade given by the teachers, as well as marks given by the other groups and by the participants of the same group (accounting for 50%, 30%, and 20% of the final mark respectively) following the instructions and rubrics showed in [Fernández-Raga et al. \(2019\)](#). Peer evaluation makes students more aware of their ability and performance on their tasks.

One problem with this activity was that a part of the students were not involved from the first moment. In general, the collaboration between the Spanish and French students of both countries was active during the two months when they worked together.

Most of the students started with a lot of enthusiasm, thinking they would get to know other people. But when they started group work they were confronted by some difficulties they had not taken into account, like reaching an agreement on the topic or on the methodology to use as a team with people that they did not know, and in another language. Their first reaction to these problems was to ask their teachers for help; however, the teachers needed to guide them but without taking decisions so that students could decide by themselves. Our experience shows that after teachers listened and analyzed the situation with them, students managed their teamwork without any trouble.

Another difficulty in our activity was the different background knowledge. Our students belonged to different courses (second and fourth year) and this meant

that fourth year students were thought of as leaders of the project, a role they did not always want to accept. The solution was again negotiation within each group. This issue was addressed by highlighting that the VE part would be done only during the months of February and March, when the international teams had to design a common project, which could be added to the ones developed previously in the Shared Garden. Sometimes, however, the French students felt demotivated and were losing momentum because they considered they had finished their practical work in February, while the Spanish students were getting ready to start the project. During the first year, this issue was solved by talking with their respective teachers, and in the second year by informing the students of the complete calendar of the project. After the final presentation, the perspective of all the students was more positive about the activity because the results were evident. After asking them through a questionnaire to provide their personal opinion about the activity, and the evaluation by their peers, they provided positive answers, and their self-evaluation made them conscious of their improvement. An increase in student motivation and involvement was noticed, as well as an improvement in their communicative ability in English. In addition, this VE project reinforced their teamwork abilities, and their use of new technologies, which are the basis to allow communication between team members who are in two different countries. As mentioned in [Fernández-Raga et al. \(2019\)](#), it also allowed the development of other skills such as better time management, individual responsibility in the assigned tasks, and improved communication with non-experts, since the teachers who collaborated in the project belong to different complementary areas and these aspects were valued in the evaluation rubrics.

Also, another advantage was the introduction of instructions on how students should be evaluated and evaluate their peers, because this allows the students to feel empowered in their learning (see [Fernández-Raga et al., 2019](#), for the rubric). And the last advantage was that the objective of each iteration of the VE project was to contribute to a more sustainable garden, which will be developed with the ideas of the students year after year, developing and implementing the strategic objectives of Agenda 2030.

5. Lessons learned and conclusion

This project was highly valued by the students from both institutions since it prepared them for their future professional life in many ways. Indeed, the students have to be autonomous and come up with new ideas, which they have to share and communicate using a foreign language. They also have to work in teams, which might be difficult for some of our students, especially for the French cohort, who are younger. All these activities helped the students become aware of the others' working culture and gave them some keys to a successful professional career. Companies are now looking for students and professionals who are flexible, versatile, and open to others, and this project helps them face these challenges. So even if these activities did not exactly fit in a language course or in a fluid mechanics course, the project showed the students how enriching interdisciplinary projects can be both personally and professionally.

The specificity of this PBL is that it includes collaborative work in teams using English, incorporating VE activities. This means that it enriches the number of skills developed thanks to the combination of PBL with intercultural interaction, like improvement in language skills or work in international environments.

This activity allows the project to adapt to different time frames, different specialties, and different numbers of students. The objectives have been fully achieved since the students indicated that they felt that they had learned to express themselves better when communicating with non-experts, had lost their fear of expressing themselves in a foreign language, and were better able to evaluate themselves and their peers. During the second iteration, carried out in the academic year 2019-2020, the realization of PBL with the French students was easier because the students themselves transmitted the objectives pursued to the younger students and they were more involved from the beginning. In any case, a longer period doing PBL (from two to four months working all together for example) will help in the development of competences such as teamwork, better organization, and cooperation.

Our opinion is that this activity should be enriched with a blended mobility of a week for the students in each country. This would be very attractive for the students, and would help develop strong bonds with their project peers. It would also develop the internationalization of both institutions.

In any case, this initiative can be easily adapted and launched in any other degree course and subject, by searching for challenges that may be attractive to students, and looking for students and teachers willing to collaborate internationally. There is no requirement for teachers to belong to the same area, since a multidisciplinary focus represents the general environment of a company where there are many more multicultural and multidisciplinary teams that allow carrying out projects with greater complexity.

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